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(54) **Security of printing articles**

(57) There is disclosed a security printing system involving the use of thermochromic inks printed on an article such as a lottery ticket or pre-paid telephone card having an amount of credit thereon for use in a mobile telecommunications network. Two layers of thermochromic ink are applied to the article each having a different and sufficiently separate activation temperatures at which a certain characteristic of the ink changes, for example its colour, opacity, transparency or translucency. The first applied layer, in the shape of a validation mark or the like, ideally has an activation temperature higher than the second layer applied thereover, so that two separate tests can be performed on the article. A first test is the application of heat to the mark by a human finger or the like whereupon the second layer becomes ideally transparent to reveal the validation mark. The second test is the application of more heat, for example by a hairdryer or other dedicated heating apparatus, whereupon a particular characteristic of the first ink changes.

## Description

[0001] This invention relates to security printing of articles, whereby the authenticity of the article can be checked subsequent to its manufacture.

[0002] The invention has particular, although not exclusive, application to the printing of tickets, cards and the like articles.

[0003] Tickets, such as lottery tickets, and cards, such as prepaid telephone cards have a value much greater than the value of the materials from which the tickets or cards are constructed, and hence they are attractive to the fraudsters because if such fraudsters can reproduce the cards and sell them at their normal or even lesser prices, then there is considerable illegitimate profit to be made. In consequence, much effort and time has been put into providing such cards and tickets with security devices, such as hidden codes, layers of foil material (so that the fraudster cannot see through the tickets or cards using strong light) and other devices.

[0004] One known device which has been adopted is the provision of a thermochromic layer which is printed on the ticket or card. A thermochromic ink layer is one which essentially changes colour, but the word thermochromic hereinafter is to be taken to mean the ability of an ink to change one or more of its physical characteristics such as colour, translucency, optical variability or transparency during the application of heat thereto or the extraction of heat therefrom. The basic idea is that the thermochromic layer will cover a validation mark or symbol word or other device and if the purchaser of a ticket wishes to validate the ticket he simply places a finger or thumb on the thermochromic ink, which loses its colour or becomes transparent and the security mark is revealed. When the heat of the finger or thumb is removed, the thermochromic layer returns to its original state again concealing the security mark.

[0005] Unfortunately fraud is not only at the level of the user of these cards and tickets, but also takes place earlier on in the manufacturing and distribution chain. For example an unscrupulous dealer in the cards could well produce the whole set of fraudulent cards or tickets with the finger validation feature. Accordingly additional security measures are highly desirable so that for example checks can be carried out to see whether or not there is any fraud at an earlier level in the manufacture and distribution chain.

[0006] This invention seeks to provide a security arrangement for articles, which has a high degree of security.

[0007] In accordance with the present invention there is provided a security feature on an article comprising a first validation means printed in a first thermochromic ink having a physical characteristic which changes at a first activation temperature, and a second validation means printed in a second thermochromic ink having a physical characteristic which changes at a sec-

ond activation temperature, characterised in that one of the inks has an activation temperature between an ambient article temperature and human body temperature such that the application of a human finger over said security feature alters the appearance of said security feature in a first manner noticeable to the naked eye, the second activation temperature being different from that of the first ink which results in an alteration of the appearance of said security feature in a second manner when said security feature is cooled or heated to a temperature lesser or greater than the second activation temperature.

[0008] Preferably the activation temperature of one of the inks is substantially equal to human body temperature.

[0009] Preferably the second ink is printed at least partially over the first ink and the security feature is defined in the overprinted region.

[0010] Preferably, the thermochromic ink layers are of different colours such that the validation means is manifested in a colour change in the security feature.

[0011] Preferably the security feature includes an image printed in a solid ink on the article which is obscured at least partially by one or other of the said thermochromic layers. Optionally, the image may also be printed in a thermochromic ink.

[0012] Preferably the solid ink image is printed directly on the article, the thermochromic ink layers being provided thereover. In an alternative embodiment, the solid ink image is printed over a first of the thermochromic layers and beneath a second thermochromic layer so as to be disposed between said layers.

[0013] In an alternative embodiment, one or other or both of said thermochromic ink layers are printed in a particular pattern to define at least one validation mark which appears, disappears, becomes more or less visible, or changes colour on application of a human finger.

[0014] Preferably the second activation temperature is higher than that of the thermochromic ink having an activation temperature equal to the human body temperature. Alternatively one of the thermochromic ink layers may be cryothermic in that its activation temperature is below 0°C, or at least much lower than human body temperature.

[0015] It is preferable that the uppermost thermochromic ink layer is cryothermic.

[0016] In a preferred embodiment, the thermochromic ink layer having the lower activation temperature is disposed beneath that having the higher activation temperature.

[0017] In the use of the article having the security printing of the invention, the ultimate user can check the security of the article by applying a finger or thumb to the security printed area, which has the effect of rendering the second layer transparent, in the preferred colourless, so that the validation mark becomes visible. This will usually be acceptable to the user, but should it be that the manufacturer, the customer for the articles,

or the agent who distributes the articles, wishes to perform additional security check, then he can do so by heating up (or freezing) the article in the region of the security feature. The heating may be done simply by placing the article on a conventional central heating radiator, or by using a hot air producing device, such as a hair dryer.

[0018] The first thermochromic ink may be of such a nature that a physical characteristic of the ink changes at a temperature in the region of 37°C, whilst the second thermochromic ink may be of such nature that it becomes transparent or translucent at a temperature in the order of 27°C for use in countries, such as the United Kingdom, which have temperate climates, but these temperatures are only guides as the activation temperatures can be varied as required. For example, it the article is to be tested in a cold climate or a hot climate, then inks with appropriate activation temperatures different from the above may be needed. Obviously, there should be a sufficient gap between the activation temperatures of the two layers, to ensure that the first ink is not activated by the thumb or finger heat.

[0019] The activation of the first ink by the application of heat will also cause activation of the second ink. The second ink may preferably be of the type which reverts to a condition in which it obscures the validation mark, but the ink of the first layer need not be revertable. When it is activated by heat, the change may be permanent.

[0020] For additional security, either thermochromic ink layer may be formulated to include a fluorescent or iridescent material so that it will fluoresce when activated. Thus even if the colour of the validation mark disappears when heat is applied, the mark may still fluoresce when subjected for example to ultra violet light

[0021] The second ink may also be modified so as to make it "optically variable", which means that it has a different appearance when viewed in different directions. This is achieved in one example, by the use of platelets in the formulation. This optical effect is similar to the effect achieved by holographic printing.

[0022] The invention has particular application to rendering more secure articles such as lottery tickets, and telephone cards, especially the latter, but it will be clear that it can be applied to any article the checking of the security of which by the means of the invention, provides an advantage.

[0023] When the invention is used as security means in connection prepaid telephone cards, the cards may be sold in a clear wrapper, and the activation of the first ink using a finger or thumb, can be effected through the wrapper, which is a considerable advantage as a purchaser can test the validity of the card without removing the wrapper. This provides extra security, as it is not unknown for fraudsters to photocopy genuine card and simply photocopy them and sell the photocopies, and it is only when the user tries to use the card that he finds out that it is a fake.

[0024] It is important to point out that in accordance with the invention, there is no need for any particular solid ink image or validation mark to be incorporated within the security feature, and validation of the article may be simply effected by viewing colour changes in certain portions of said article. For example, if the thermochromic ink layers are of different colours, e.g. blue and yellow, then the inactive colour of the security feature will be green. The application of a human finger will cause a first colour change from green to blue as the yellow layer loses its colour, whereas raising or lowering the temperature of the security feature to the second activation temperature may result in a colour change from green to yellow. As the blue layer changes state. It will be appreciated by the skilled person that a vast number of combinations and permutations is available when it is realised that a solid ink image having a third colour may be provided between or beneath the two thermochromic layers, and that the thermochromic layers themselves may be printed in certain patterns defining a validation mark. In one embodiment, the invention thus arises as a result of the interplay between the two thermochromic layers.

[0025] The invention thus provides two levels of security. The first level provides for easy, quick and simple verification that the ticket is genuine, and this security feature may even result in the articles themselves being popular as the public can verify said tickets. The second level of security would not be disclosed to the public so manufacturers and the vendors of the articles could perform a second check to establish whether a suspect ticket was genuine.

[0026] A wide variety of thermochromic inks is now available and in colours essentially identical to the colours of conventional printing inks. Solid ink images can therefore be totally obscured by colour matching with the thermochromic ink, and variation in film weight of the thermochromic layer (which is easily achievable because the thermochromic ink can be printed by any conventional commercial printing method) results in more or less rapid activation as required.

[0027] An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing, wherein:-

Fig. 1 is a perspective view of a telephone card provided with security printing according to the invention;

Fig. 2 is a sectional elevation of the card shown in Fig. 1;

Figs 3, 4 and 5 show how the card of Fig. 1 can be validated in two levels of security.

[0028] Referring to the drawings, a telephone card 10 is of conventional construction, but additionally is provided in an area 12 with the security printing accord-

ing to the invention. The card 10 in this example may be contained for example in a clear material wrapping 14, for added security in that the wrapping must be removed before the card can be used. In another section 16 there is a suitable code which identifies the manufacture and/or batch number of the card for the second layer of security checking as is explained to you hereinafter.

[0029] As shown in Fig. 2, the card 10 comprises a substrate 16 of conventional construction, and it may comprise paper, plastic, foil or paper/plastic/foil laminate in any combination, or other suitable material. On the surface of the card 16 is applied the security printing 12, and this printing comprises a first layer 18 of a first ink which is thermochromic in nature and may also have a fluorescent additive. The first layer 18 defines the validation mark for the card, and this is covered by a second thermochromic layer 20 which also is optically variable as discussed above, again for added security.

[0030] The layer 20 as shown in Fig. 1 covers all of the area 12 and its function is to obscure the layer 18 from view, but the thermochromic nature of the layer 20 is such that the obscuring capability of the layer 20 can be removed by the application of a finger or thumb 22 as shown in Fig. 3 to the area 12. The heat from the finger or thumb causes the obscuring nature of the layer 20 to be removed so that it becomes, in known manner, translucent or transparent so that the validation mark 18 becomes visible, as shown in Fig. 4. When the finger is removed, in the fullness of time the layer 20 will revert to its original colour, once more obscuring the validation mark. It is preferred that the validation mark be printed in the same colour or a matching colour to that of the obscuring layer 20 to ensure maximum obscuring effect, but this is not necessary in all embodiments of the invention.

[0031] The layer 20 may be adapted to be activated, that is to become translucent or transparent at a temperature selected depending upon the climate in which the article is to be used, and for moderate climates the activation temperature may for example be in the region of 27°C.

[0032] The thermochromic nature of the validation mark 18 however is such as to be activated at a substantially higher temperature, for example in the order of 37°C when ink 20 is activated at 27°C. The ticket can therefore be checked to a second level of security by heating it beyond the activation temperature of the layer 20, and when such heating takes place, for example by heating the ticket with a hot air blower or simply putting it on a radiator of a conventional central heating system, the validation mark eventually in this embodiment disappears as shown in Fig. 5, thereby providing a second level of security.

[0033] As the card cools down, so the validation mark will return and indeed the layer 20 will also return but the card will eventually return to the condition shown in Fig.1.

[0034] For still further added security, the ink which

is used for the validation mark 18 may also contain a fluorescing material so that even in the condition shown in Fig. 5, the validation mark can be examined by using for example an ultraviolet source in which case the validation mark will appear in a fluorescent print form.

[0035] Should any ticket be counterfeited, then the user would be able to identify this immediately on placing the finger or thumb on the area 12, but if the ticket passes that test, then if it fails the second test then use can be made of the code 16 in order to identify the source of the fraud.

[0036] These measures will lead to a reduction in fraudulent dealing cards and tickets of this kind, and can also be used in relation to any other article whose validity is to be checked.

[0037] The thermochromic inks which are used in the present invention may need to be specially formulated, but there are available commercially thermochromic inks which operate in the manner described and are active at different temperatures, and these can be used in the instant invention.

#### Claims

1. A security feature for an article comprising a first validation means printed in a first thermochromic ink having a characteristic which changes at a first activation temperature, and a second validation means printed in a second thermochromic ink having a physical characteristic which changes at a second activation temperature, characterised in that one of the inks has an activation temperature between an ambient article temperature and human body temperature such that the application of a human finger over said security feature alters the appearance of said security feature in a first manner noticeable to the naked eye, the second activation temperature being different from that of the first ink which results in an alteration of the appearance of said security feature in a second manner when said security feature is cooled or heated to a temperature lesser or greater than the second activation temperature.
2. A system according to claim 1 characterised in that the activation temperature of one of the inks is approximately equal to human body temperature.
3. A system according to any preceding claim characterised in that the second ink is printed at least partially over the first ink and the security feature is defined in the overprinted region.
4. A system according to any preceding claim characterised in that the thermochromic ink layers are of different colours such that at least one of the validation means is manifested in a colour change in the security feature.

5. A system according to any preceding claim characterised in that the security feature includes an image printed within said security feature prior to overprinting thereof with one or more thermochromic ink layers. 5
6. A system according to any preceding claim characterised in that the image is printed in a solid ink on the article and is overprinted at least partially by one or other of the said thermochromic ink layers. 10
7. A system according to claim 5 wherein the image is printed in a thermochromic ink and is overprinted at least partially by one or other of the said thermochromic ink layers. 15
8. A system according to any of claims 5 to 7 characterised in that the image is sandwiched at least partially between the first and second thermochromic ink layers. 20
9. A system according to any of claims 5-7 characterised in that the image is printed on the article and is overprinted at least partially by first and second thermochromic ink layers. 25
10. A system according to any preceding claim characterised in that one or other or both of said thermochromic ink layers are printed in a particular pattern to define at least one validation mark having a thermally sensitive characteristic on application of a human finger. 30
11. A system according to any of claims 2-10 characterised in that the second activation temperature is higher than that of the thermochromic ink having an activation temperature approximating to human body temperature. 35
12. A system according to any of claims 2-10 characterised in that one of the thermochromic ink layers is cryothermic in that its activation temperature is below 0°C. 40
13. A system according to claim 12 characterised in that the second and uppermost thermochromic ink layer is cryothermic. 45
14. A system according to any of claims 2-12 characterised in that the thermochromic ink layer having the lower activation temperature is disposed beneath that having the higher activation temperature. 50
15. A system according to any preceding claim characterised in that the first thermochromic ink possesses a physical characteristic which changes at a temperature in the region of 37°C. 55
16. A system according to any of claims 1-14 characterised in that the second thermochromic ink becomes transparent or translucent at a temperature in the order of 27°C.
17. A system according to any preceding claim characterised in that at least one of the first and second thermochromic ink layers possesses a thermally sensitive characteristic which changes permanently after application or extraction of heat.
18. A system according to any preceding claim characterised in that at least one of the first and second thermochromic ink layers includes a fluorescent or iridescent material such that said layer fluoresces or becomes iridescent when activated.
19. A system according to any preceding claim characterised in that at least one of the first and second thermochromic inks is optically variable
20. A system according to any preceding claim characterised in that the second uppermost thermochromic ink layer is further provided with a solid ink overprint.
21. A telephone card having printed thereon a security system as detailed in any preceding claim.
22. A card according to claim 21 characterised in that said card is provided in a clear translucent wrapper through which heat can be applied to the security system without the need to remove said wrapper.

